# Feedbacks Between Bottom Roughness, Bioturbation Intensity And Epibenthic Microalgae

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## LONG-TERM GOALS

The ultimate objective of this research program is to identify and obtain a predictive understanding of the physical and biological processes responsible for the formation and maintenance of the microtopography (decimeter to millimeter) of the sea floor. To achieve this goal, it is necessary to study formative processes occurring on the sediment surface (e.g., biogenic mound formation, ripple development), as well as processes occurring within the seabed (e.g., bioturbation, compaction) which generally lessen microtopography. The approach to this area of interest is predominantly field-oriented, with a secondary emphasis on model development.

## OBJECTIVES

The objective of this project, which is part of the Coastal Benthic Optical Properties (**CoBOP**) DRI, is to study the impact of bottom roughness (biological and physical) and bioturbation on benthic optical properties, in particular the small-scale distribution of epibenthic microalgae. Field studies at a sediment site offshore of Lee Stocking Island, Bahamas in which co-located measurements of bottom roughness, sediment bioturbation rate and epibenthic microalgal abundance are made on multiple spatial (cm to 10's m) and temporal (hours to months) scales are continuing. Focus during this biennium is on elucidating the mechanisms leading to the observed patterns of roughness and microalgal biomass.

## APPROACH

Measurements of bottom roughness are made either using a 35-mm PhotoSea 2000 metric stereocamera mounted on a neutrally-buoyant, diver-manipulatable vehicle (“survey”) or using a similar stereocamera mounted on a tripod (“time-lapse”). Following standard film development, the images are digitized at a high resolution (i.e., > 4000 ppi) by a third-party aerial mapping firm and stored on CD-ROMs. Sea floor height information is obtained from analytically rectified (epipolar transformation) digital stereo-images using matching algorithms.

Independent, co-located measurements of sediment bioturbation intensity and mode are made during the field studies. The bioturbation measurements involve the spreading of glass beads onto a patch of sea floor, followed by tube coring and vertical sectioning after periods of days to months. Tracers are enumerated by dissolving the ambient carbonate grains.

# Report Documentation Page

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To non-destructively measure microalgae distribution and, potentially, biomass, we are using time-lapse and survey fluorescence photography. This technique relies on outgoing UV radiation from filtered strobe light to stimulate fluorescence by the algae, which is captured on film that has a UV-blocking filter.

## WORK COMPLETED

Field activities during FY 99 included the six-week deployment of a time-lapse bottom tripod in April-May at the North Perry Reef site off LSI. The tripod supported a stereocamera, an acoustic Doppler velocimeter (ADV) and a fluorescence camera. The deployment was of mixed success, with a full set of data from the ADV and its related sensors, but only partial data sets from the two cameras.

During the main CoBOP experiment in May, the time-lapse stereocamera was redeployed for 10 days, several survey runs were conducted, and additional bioturbation experiments were conducted at the N. Perry site. All of these activities were successful.

Laboratory analyses have focused on generation of accurate digital elevation models (DEMs) for the May 1998 time-lapse and survey stereophotographs and measurement of down core tracer distributions.

## RESULTS

There are two sources of roughness at the study site: (1) physically-produced wave ripples, and (2) biogenic structures (e.g., mounds, fish-feeding pock marks, tracks and trails). Except for a few mounds the latter are of lesser relief. Hence, we expected the roughness to decline as one approached the reef, due to the higher abundance of demersal, sediment-foraging fish near the reef. Surprisingly, measurements of rms-height and total relief in meter-square areas of the seafloor do not show any relationship with distance from the reef (Fig. 1). Similarly, rms-height and total relief does not change significantly over the course of a 10-day deployment.

While higher order measures of roughness, such as autocorrelation or structure functions have not been completed, the rms-height results suggest that the direct impact of geometrical roughness on bottom reflectance may be relatively steady in time and (for the area near N. Perry reef) spatially uniform.

## IMPACT/APPLICATIONS

The development of a photographic system capable of quantifying sea floor microtopography is likely to have widespread application in marine geology. For example, studies of sediment transport and acoustical interactions with the sea bottom would both benefit from knowledge of the short-term evolution of bottom roughness.

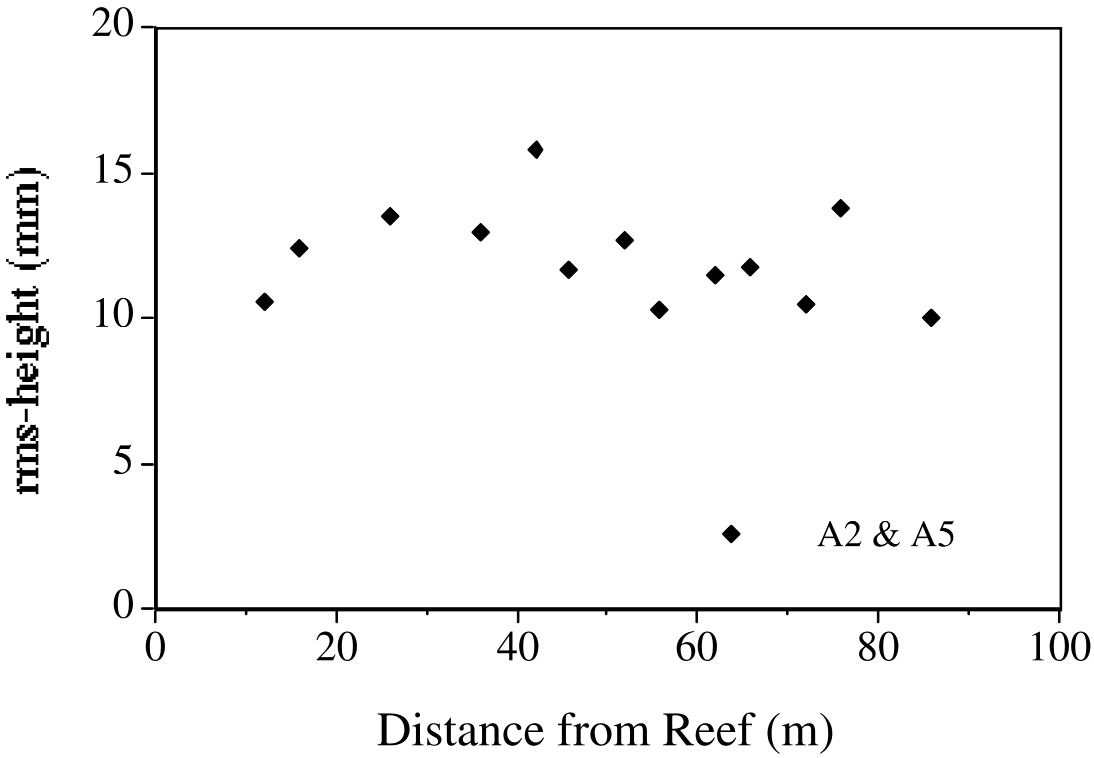


*Fig. 1. Rms-height determined from digital elevation models of 80 by 60 cm areas of seafloor.*

## TRANSITIONS

No transitions are currently known.

## RELATED PROJECTS

Discussions have been initiated with Drs. Larry Brand and Charlie Mazel regarding the epibenthic diatoms observed at the N. Perry site, with a recolonization experiment planned for May 2000. In addition, collaborations with Drs. Emmanuel Boss and Ron Zaneveld (OSU) regarding CDOM fluorescence and Dr. Robert Maffione regarding time-lapse IOPs are ongoing.